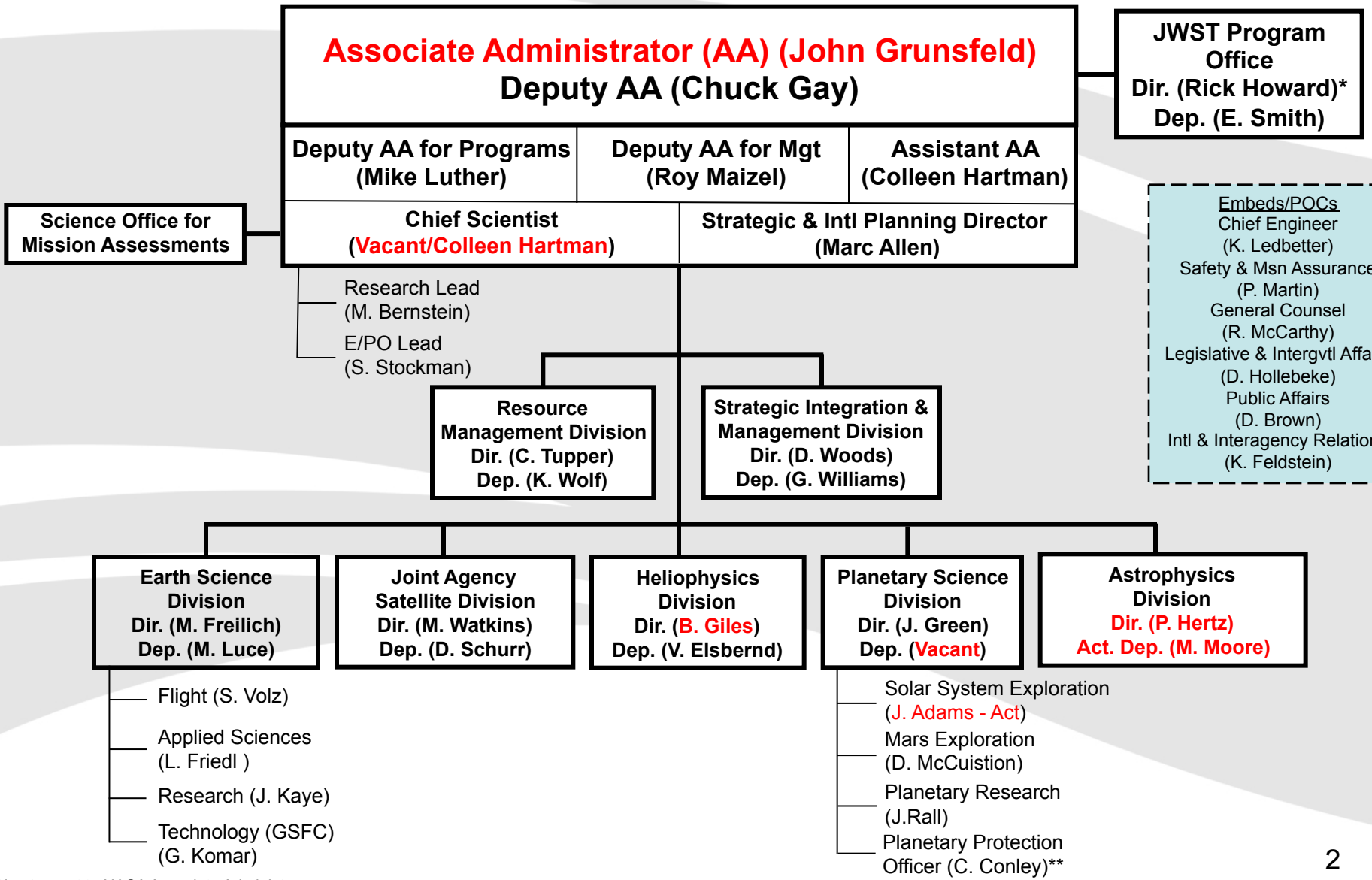
National Aeronautics and Space Administration

NASA's Earth Science Division

Bureaucratic Overview for the MODIS Science Team

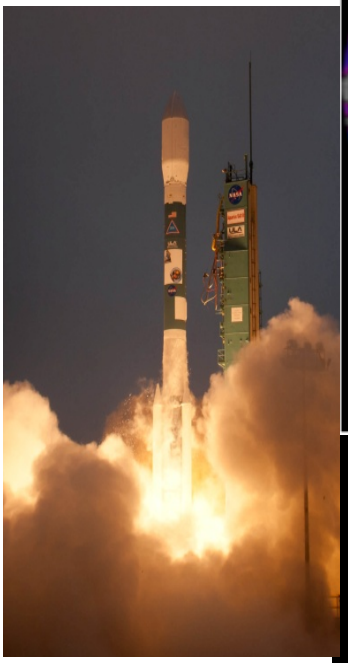
7 May 2012

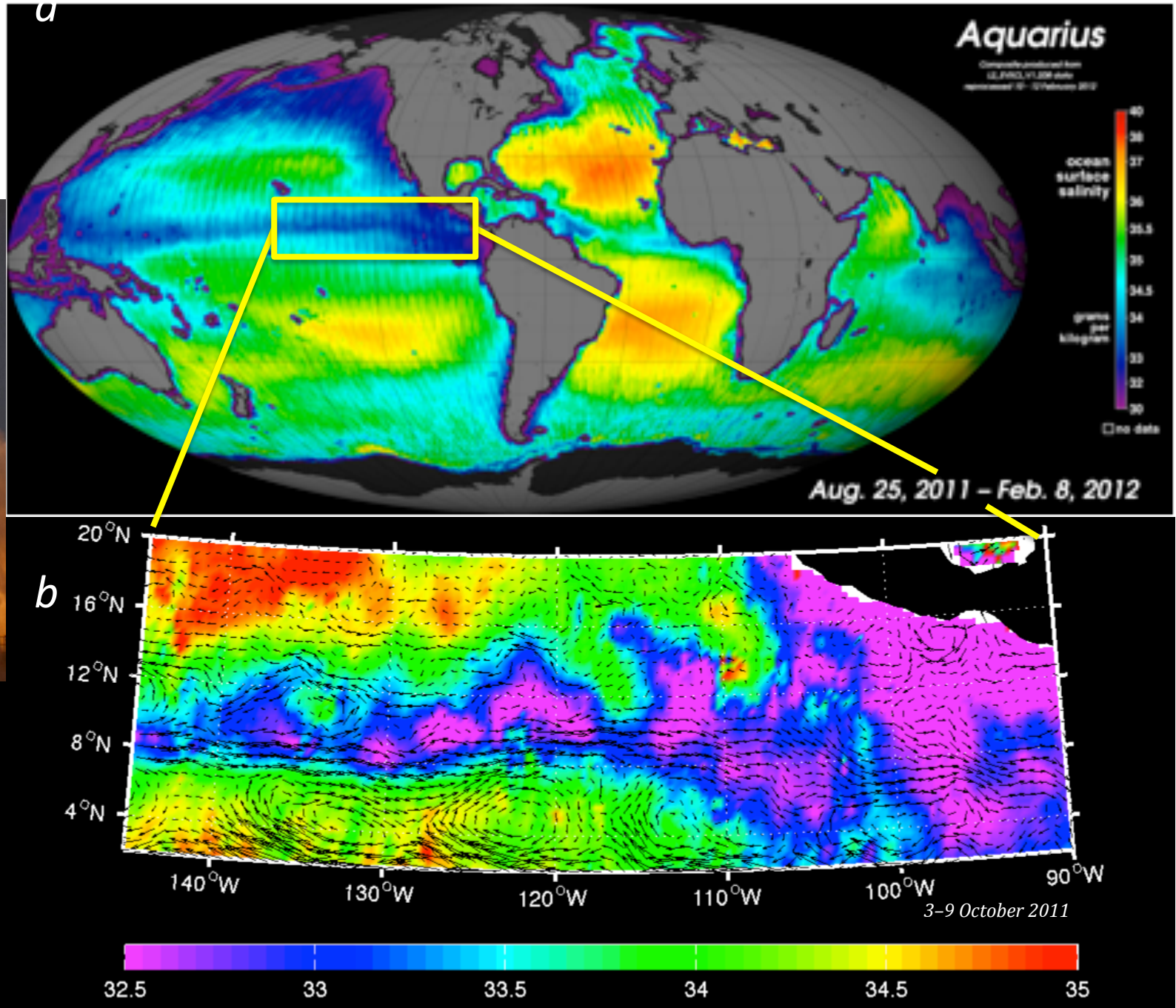
SMD Organization



* Direct report to NASA Associate Administrator
** Co-located from the Front Office


Launch-CY2011
Launch-CY2012
Launch-CY2013
Aquarius
OSTM/Jason 2 (NOAA)
Jason
QuikSCAT*
TRMM
EO-1
Landsat-7 (USGS)
Aqua
ACRIMSAT
Terra
SORCE
LDCM
Aura
GRACE (2)
CALIPSO
CloudSat
Suomi-NPP




a
Aquarius
ocean surface salinity
grams per kilogram
no data
Aug. 25, 2011 – Feb. 8, 2012
b
20°N
16°N
12°N
8°N
4°N
140°W
130°W
120°W
110°W
100°W
90°W
3–9 October 2011
32.5
33
33.5
34
34.5
35

Suomi NPP Mission

Suomi NPP provides critical data continuity for Earth science research and risk reduction for JPSS instruments, algorithms, ground system, and archive.

Suomi NPP will continue essential climate, weather, and environmental data from polar orbit:

NASA	NOAA
AIRS → CrIS	HIRS → CrIS
AMSU → ATMS	AMSU → ATMS
MODIS → VIIRS	AVHRR → VIIRS
OMI → OMPS	SBUV2 → OMPS
CERES → CERES	

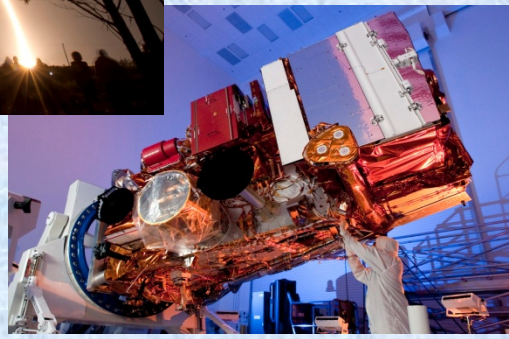
Anticipated Benefits

- Tracking Climate Changes – *measurements to understand climate and the health of our planet*
- A Vigilant Eye on Ozone – *daily measurements to assess recovery of the ozone layer*
- A Sentinel When Disaster Strikes – *wildfires, volcanic eruptions, snowstorms, droughts, floods, hurricanes*
- Watching the Weather – *soundings of atmospheric temperature and moisture, cloud cover*

NPP Instruments

- Visible Infrared Imaging Radiometer Suite (VIIRS)
- Cross-track Infrared Sounder (CrIS)
- Advanced Technology Microwave Sounder (ATMS)
- Ozone Mapping and Profiler Suite (OMPS)
- Clouds and the Earth's Radiant Energy System (CERES)

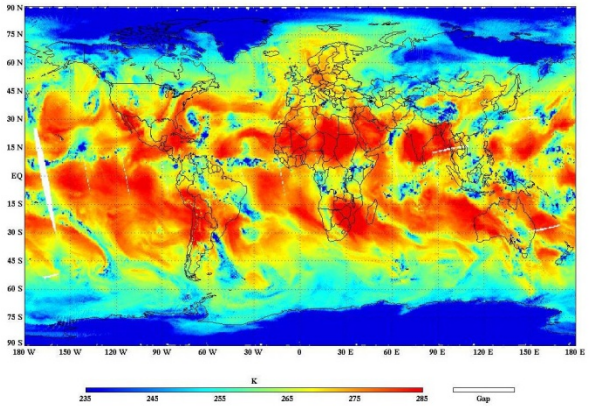
→ Only CERES has flown in space before, the four other instruments are new designs.



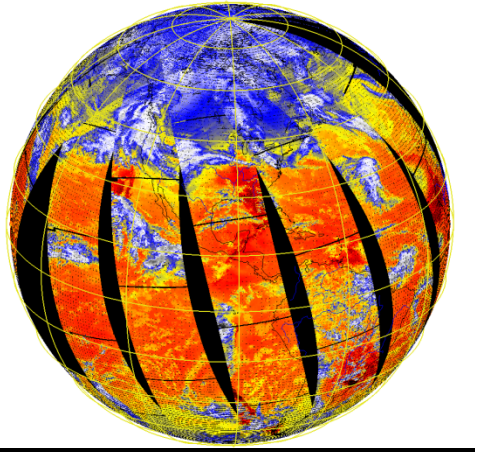
Launched : October 28, 2011

Suomi – NPP Products

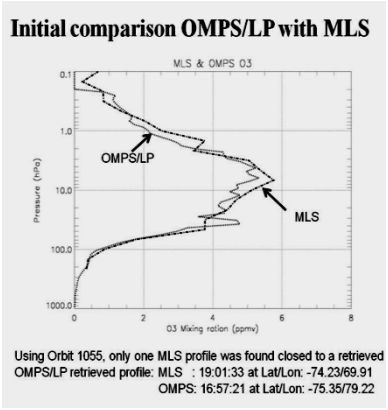
ATMS



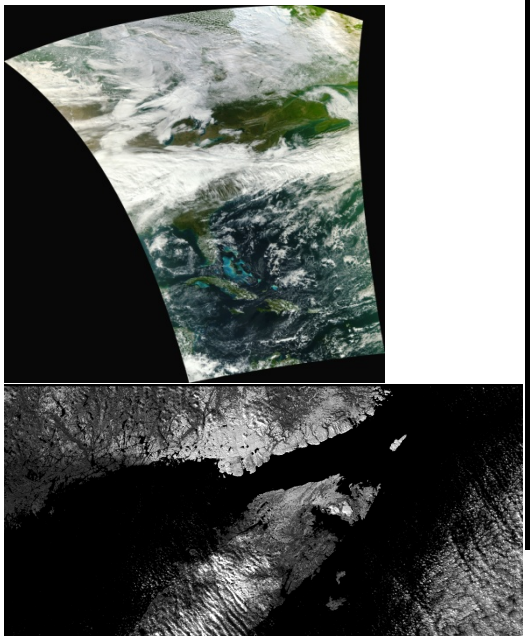
CrIS



OMPS

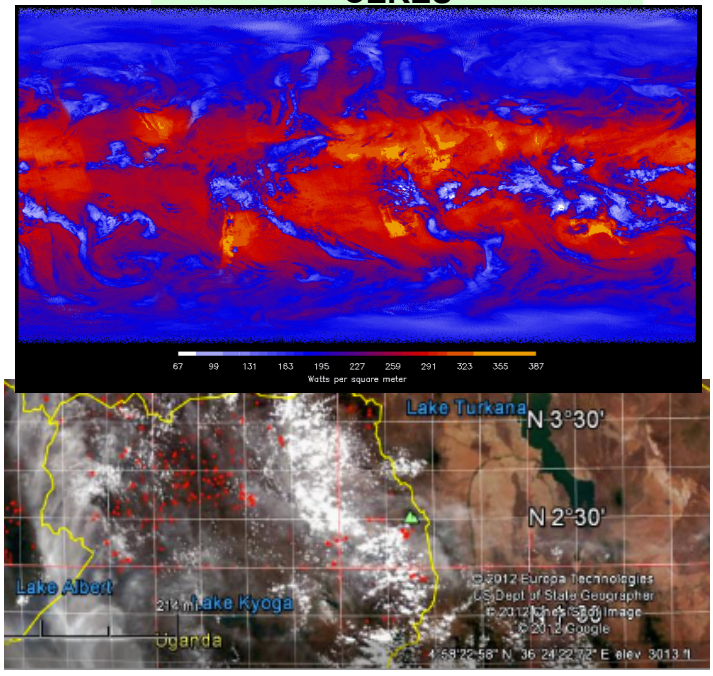


VIIRS 1st Image



VIIRS Night, Visible & Fires

CERES



Earth Decadal Survey Mid-Term Report

An Assessment of NASA's Earth Science Programs

Dennis Hartmann, Committee Chair
University of Washington

Art Charo, Study Director
Lewis Groswald, Research Associate
National Research Council-Space Studies Board

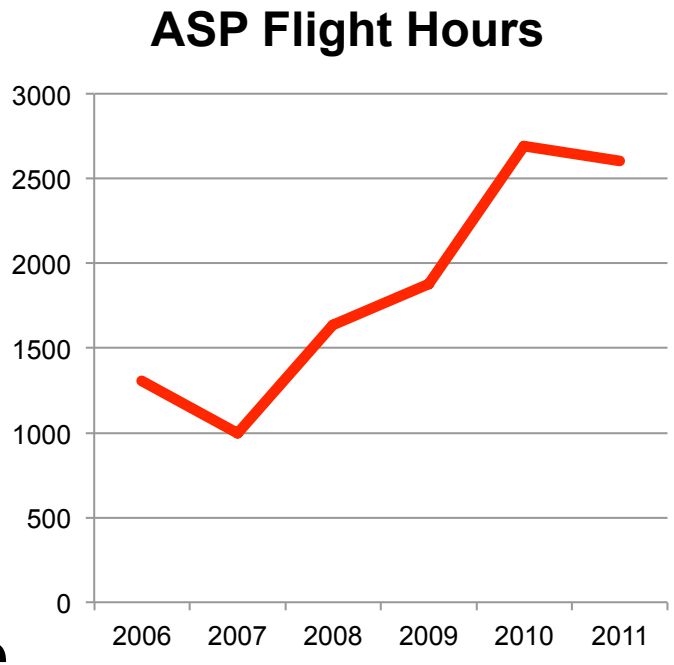
Findings

- **Finding**: NASA responded favorably and aggressively to the decadal survey, embracing its overall recommendations for Earth observations, missions, technology investments, and priorities for the underlying science. As a consequence, the scientific and applications communities have made significant progress over the past 5 years.

Findings (Cont'd)

- **Finding:** The **Earth Venture class program** is being well implemented by NASA and is a crucial component of fulfilling the decadal survey's objectives.
- **Finding: Alternative platforms and flight formations** offer programmatic flexibility. In some cases, they may be employed to lower the cost of meeting science objectives and/or maturing remote sensing and *in situ* observing technologies.
- **Finding:** NASA has made considerable efforts to secure **international partnerships** to meet its scientific goals and operational requirements.
- **Finding:** Aligned with the intent of the decadal survey, NASA's **Applied Sciences Program** has begun to engage applied researchers and governmental (federal and state) operational users on some survey mission science definition and applications teams and conduct research to better understand the value of these applications.

Findings (Cont'd)



- **Finding:** The suborbital program and, in particular, the **Airborne Science Program**, is highly synergistic with upcoming Earth science satellite missions and is being well implemented. **NASA has fulfilled the recommendation of the decadal survey to enhance the program.**
- **Finding:** NASA has **maintained a healthy investment in R&A activities and has protected the budgets** of both mission-specific and non-mission-specific R&A programs against possible reallocation to cover cost growth in mission hardware.

Principal Impediment to Achieving Survey Recommendations

- **Finding:** Funding for NASA's Earth science program has not been restored to the approximate $2 billion per year (in FY 2006 dollars) level needed to execute the decadal survey's recommended program. The failure to restore the Earth science budget to a $2 billion level is a major reason for the inability of NASA to realize the mission launch cadence recommended by the survey.

Other Impediments

- **Finding:** The decadal survey's recommendation that the Office of Science and Technology Policy develop an interagency framework for a sustained global Earth observing system has not been implemented. The committee concludes that the lack of such an implementable and funded strategy has become a key, but not sole, impediment to sustaining Earth science and applications from space.

Impediments (Cont'd)

- **Finding:** NOAA's capability to implement the assumed baseline and the recommended program of the decadal survey has been greatly diminished by budget shortfalls and cost overruns (especially those associated with the development of the NPOESS, now JPSS, program) and by sensor descopes and sensor eliminations on both JPSS/NPOESS and GOES-R.
- **Finding: Lack of reliable, affordable, and predictable access to space has become a key impediment** to implementing NASA's Earth science program. Furthermore, the lack of a medium-class launch vehicle threatens programmatic robustness.

Recommendations

- **Recommendation: ESD should interpret decadal survey estimates of mission costs as an expression of the relative level of investment that the survey's authoring committee believed appropriate to advance the intended science and should apportion funds accordingly, even if all desired science objectives for the mission may not be achieved.**
  - Survey-derived cost estimates are by necessity very approximate and subsequent more detailed analysis may determine that all of the desired scientific objectives of a particular mission cannot be achieved at the estimated cost.

- **Recommendation: ESD should implement its missions via a cost-constrained approach, requiring that cost partially or fully constrain the scope of the mission such that realistic science and applications objectives can be achieved within a reasonable and achievable future budget scenario.**

Recommendations (con't)

- **Recommendation: NASA's ESD should establish a cross-mission Earth system science and engineering team to advise NASA on execution of the broad suite of decadal survey missions within the interdisciplinary context advocated by the survey.**
  - The ***advisory team would assist NASA in coordinating decisions regarding mission technical capabilities, cost, and schedule in the context of overarching Earth system science and applications*** objectives.
  - The team, similar to the Payload Advisory Panel established by NASA to assist in implementation of its Earth Observing System (EOS), would draw its membership from the scientists and engineers involved in the definition and execution of decadal survey missions as well as the nation's scientific and engineering talent more broadly.

Recommendations (con't)

- **Recommendation: NASA should seek to ensure the availability of a highly reliable, affordable medium-class launch capability.**

- **Recommendation: Consistent with available budgets and a balanced Earth observation program from space based on the decadal survey recommendations, NASA should consider increasing the frequency of Earth Venture stand-alone/space-based missions.**

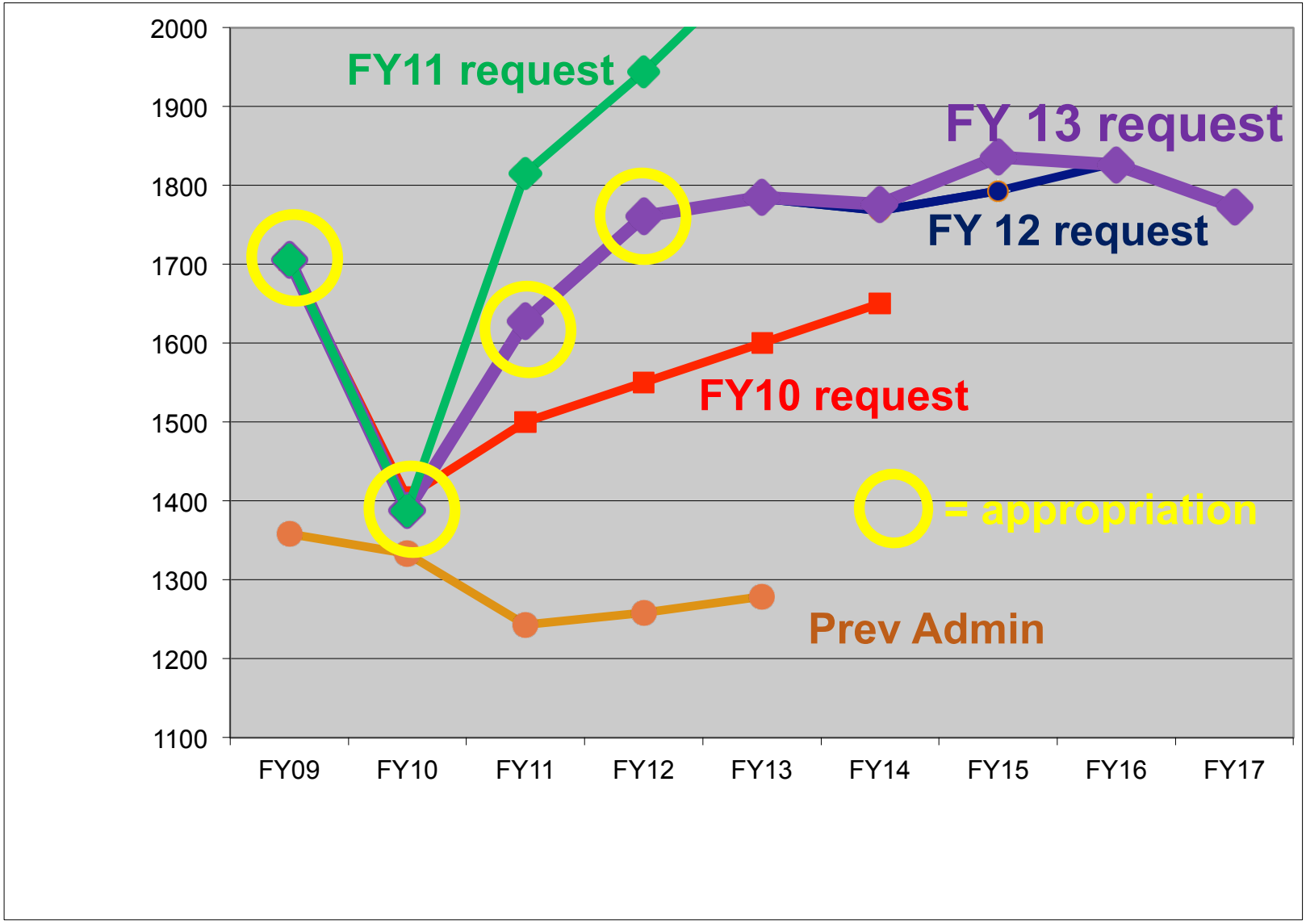
NASA “Highlights” Page from Budget Document

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Funding Highlights:

- Provides $17.7 billion, a decrease of 0.3 percent, or $59 million, below the 2012 enacted level. While making difficult choices, the Budget builds on our existing space infrastructure, continues efforts to streamline agency operations, and preserves innovative capabilities and technologies to sustain American leadership in space.
- Implements a lower cost program of robotic exploration of Mars that will advance science and will also help lay the foundation for future human exploration.
- Invests in new space technologies, such as laser communications and zero-gravity propellant transfer, which can improve America’s ability to access and operate in space and enhance the competitiveness of the U.S. space industry.
- Leverages a Federal investment of $830 million and private sector investment and ingenuity to develop a U.S. capability to transport crews into space, thereby eliminating our dependence on foreign capabilities in this area.
- Provides continued robust funding for the development of a new heavy-lift rocket and crew capsule that will take America deeper into space than ever before, create American jobs, ensure continued U.S. leadership in space exploration, and inspire people around the world.
- Provides $1.8 billion for research and a robust fleet of Earth observation spacecraft to strengthen U.S. leadership in the field, better understand climate change, improve future disaster predictions, and provide vital environmental data to Federal, State, and local policymakers.
- Funds the highest priority astronomical observatories and robotic solar system explorers, including a successor to the Hubble telescope and a mission to return samples from an asteroid, while delaying unaffordable new missions.
- Continues the effort to turn NASA’s former Space Shuttle launch facilities at the Kennedy Space Center in Florida into a 21st Century launch complex so that they can efficiently support programs like the Space Launch System and commercial operators.
- Streamlines agency operations, resulting in over $200 million in savings.

Earth Science Budget – FY13 Request

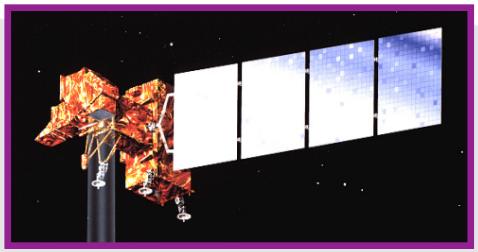


Earth Science Budget Overview

- **The FY13 budget for Earth Science is consistent with the FY12 request – *STABILITY!***
  - Congressional ***appropriation*** for FY12 was ***also*** consistent with the President's budget request
  - FY13 overall ESD funding level is ~$25M above FY12 appropriated level
  - Overall NASA agency FY13 level represents 0.3% decrease from FY12; SMD overall budget decreased by ~3.3% from FY12

- The March 2011 Glory launch failure has resulted in delays for OCO-2 and SMAP launches, and ***significantly higher budgeted cost levels for mid-range launch vehicles***
  - Solicitation for multiple launch services for OCO-2, SMAP (and JPSS-1) has been released – with higher evaluation emphasis on vehicle reliability
  - SMAP launch date: 23 Oct 2014
  - OCO-2 launch date: NET July 2014 (SMAP launch date has priority)
  - FY13-vs-FY12 decreases in R&A (1.5%), Applied Science (5%), and Technology (3.3%) lines; however, all non-flight lines increase throughout 2013-2017
- ***All 3 strands of Venture Class are fully funded throughout, with all AOs released***

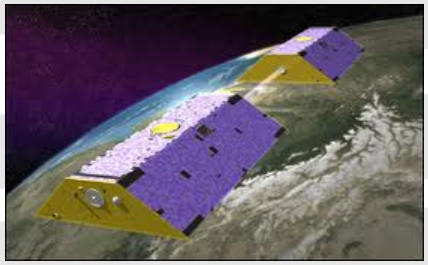
Near-Term Upcoming Systematic Missions – 3/2012



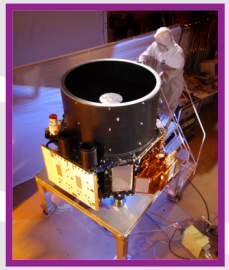
LDCM
1/2013
w/USGS; TIRS

GPM
2/2014
w/ JAXA; Precip

OCO-2
2014
Global CO_2



GRACE-FO
2017
w/DLR, GFZ (Germany)
Gravity, Ice, Grd. Water, Climate



ICESat-II
January 2016
Ice Dynamics

SAGE-III on ISS
August 2014
w/HEOMD, ESA
Atmos. Profiles

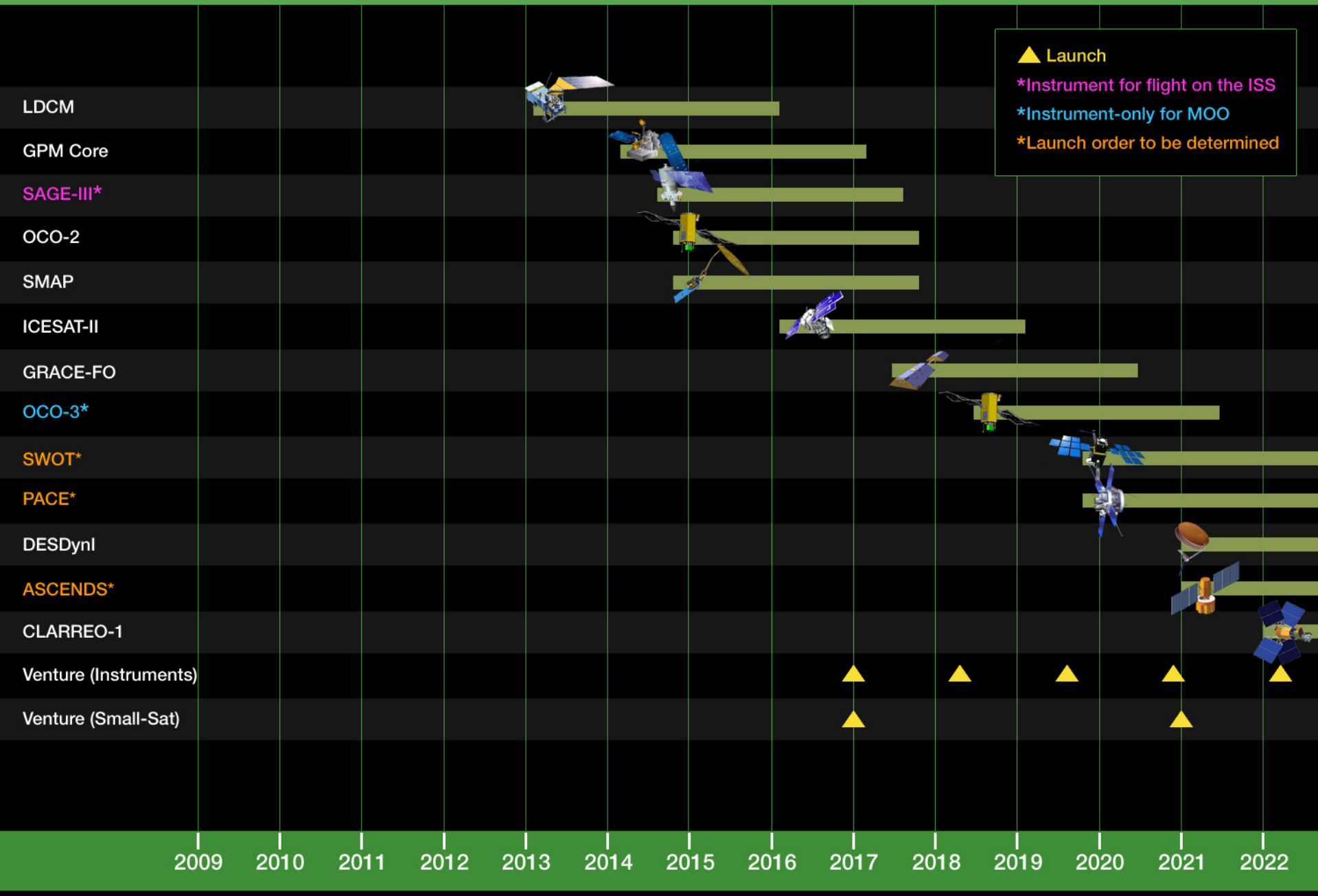
SMAP
October 2014
w/CSA
Soil Moist., Frz/Thaw

VENTURE-CLASS UPDATE/STATUS

- **Venture-Class is a Tier-I Decadal Survey recommendation**
  - Science-driven, PI-led, competitively selected, cost- and schedule-constrained, regularly solicited, orbital and suborbital
  - Venture-class investigations complement the systematic missions identified in the Decadal Survey, and provide flexibility to accommodate scientific advances and new implementation approaches

- **Venture-Class is fully funded, with 3 "strands"**
  - EV-1: suborbital/airborne investigations (5 years duration)
    - Solicited in FY09 (selections in FY10) ***and every 4 years***
    - 5 investigations selected; flights began in FY11
  - EV-2: small complete missions (5 years duration)
    - Solicited in FY11 (selections in FY12) ***and every 4 years***
    - Small-sat or stand-alone payload for MoO; $150M total development cost
    - AO released 17 June, proposals received 29 Sept 2011, under review
  - EV-Instrument: Spaceborne instruments for flight on MoO (5 years dev.)
    - Solicited in FY11 (selections in CY12) ***and every 15-18 months thereafter***
    - Final AO release Feb 7; proposals due May 8, 2012 (Ken Jucks is POC)
    - ~$90M development costs, accommodation costs budgeted separately

Future Missions timeline



BACKUP